# MONTE CARLO SIMULATIONS OF LOW CURRENT TOWNSEND DISCHARGES IN NEON

Ž. D. Nikitović, A. I. Strinić, G. N. Malović, V. D. Stojanović and Z. Lj. Petrović

*Institute of Physics, P.O.B. 68, 11080 Belgrade*
*Serbia and Montenegro*

The studies of spatial profiles of excitation reveal non-hydrodynamic behavior close to the electrodes and at high *E/N*, effects of reflection and heavy particle excitation. Understanding the kinetics of excited neon is of practical importance for modeling collisional plasmas, gas discharge devices, in particular plasma displays. The data have been obtained from drift tube and were analyzed using Monte Carlo simulation, which involved an accurate representation of non-equilibrium effects and a complete set of initial cross sections. A complete excited state kinetics analysis is however required to obtain the electron, ion and fast neutral scattering cross sections for all the 2p levels.

In the present work, we show comparison between experimental data and results of Monte Carlo simulation (MCS) [1] for excitation coefficients in neon.

We have made measurements for charged and fast neutral particle transport neon [2]. The discharge vessel that we used in our experiment consists of parallel-plane electrode system (7.9 cm in diameter separated by 1.72 cm) inside a quartz tube. The cathode was made of stainless steel and the anode of vacuum-grade sintered graphite. Discharge between the electrodes is sustained by a dc voltage, typically we cover range from the total voltage of 200 V to 2000V. Pressures from 1 Torr down few tens of mTorr were covered respectively giving a wide range of E/N. The light emitted from the discharge was detected through the quartz window of the vacuum chamber by a monochromator, photomultiplier and a photon-counting chain. Spatial profile was obtained by using 1:1 optics with 1 mm wide collimators mounted on a movable platform.

We have performed the analysis of our data for neon by using a detailed Monte Carlo simulation scheme. Monte Carlo code is based on a null-collision technique because it is applicable to our steady state Townsend conditions [3]. The code contains electron kinetics part, ion kinetics part and fast neutral kinetics part and from the analysis for all these three elements we can obtain spatial profiles of emission, the excitation coefficients and as a result of the standard swarm analysis we can obtain the cross section data. In the present range of the analysis, only electron part was relevant. Swarm analysis is performed by comparing experimental and calculated transport (excitation) coefficients. Comparisons are repeated until a satisfactory agreement is achieved after modifications of the cross sections.

The spatial profiles of excitation coefficients of $2p_8$ neon emission have been used to obtain the cross section data. In particular, such data may be used to identify heavy particle excitation [4] that is recognized by the growth of emission towards the cathode. We were able to achieve a reasonable agreement with the experimental data but further modifications to the available cross section are required to take full advantage of the experimental data. The basic set of cross sections for electron scattering was taken from Hayashi [5] and Puech [6].

## REFERENCES

[1] V.D. Stojanović and Z.Lj. Petrović, *J. Phys. D* **31** (1998) 834.
[2] G.N. Malović, J.V. Božin, B.M. Jelenković and Z.Lj. Petrović, *Nucl. Instr. Methods B* **129** (1997) 317.
[3] Z.Lj. Petrović and V.D. Stojanović, *J. Vac. Sci. Technol. A* **16** (1998) 329.
[4] B.M. Jelenković, A.V. Phelps, *Phys. Rev. A* **36** (1987) 5310.
[5] M. Hayashi – personal communication.
[6] V.Puech and S.Mizzi, *J. Phys. D: Appl. Phys.* **24** (1991) 1974.